

Trade, Employment and Wages in Sweden 1975-93

by

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Abstract

This paper investigates the effect of import competition on employment and wages in the Swedish manufacturing sector during 1975-93. Labour is divided into production and non-production workers respectively. The results show that import competition had a significant negative effect on the employment of both labour groups. The effect was larger for non-production workers than for production workers. Non-production worker real wages were not affected at all by import competition, while it had a negative effect on production worker real wages. Technological change had a significant negative effect on employment for both labour groups, and a positive effect on the real wage for non-production workers.

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1. Introduction

During the 1990's much attention has been given the issue of globalisation, technological change and the labour market outcome for unskilled labour. The U.S. and the U.K. have experienced increasing wage differentials between labour with different skill levels during the 1980's while many European countries have faced higher unemployment rates among the unskilled. One possible explanation for the deteriorated position of the unskilled on the labour market is increased international trade with low wage countries abundant in unskilled labour, which decreases the demand for unskilled labour in high wage countries. The shift in demand could also be caused by technological change that is biased against unskilled labour. Other possible explanations include changes in the relative supply of skilled labour, and a declining role of labour market institutions, concerning weaker trade unions, a decline in collective bargaining and more decentralised wage bargaining.

The purpose of this study is to analyse the effects of import competition and technological change on the employment and wages of unskilled and skilled labour in the Swedish manufacturing sector during 1975-93.

In an international comparison Sweden has a compressed wage structure (Davis 1992). Wage dispersion was about twice as high in the U.S. than in Sweden in 1984. (Edin and Holmlund 1995). Wage inequality decreased during the 1970's up to the early 1980's when it started to expand moderately. Looking at education differentials, the standardised relative wage between labour with 16 years of education in relation to labour with 12 years of education was 1.80 in 1968, 1.22 in 1984 and increased to 1.31 in 1991 (Holmlund 1997). Unemployment was low during 1970-91 varying between 1.5 and 3.5 per cent. However, the unemployment rate was higher among the unskilled than among the skilled. It was about 1 per cent for labour with more than 12 years of schooling compared to 2-4 per cent for labour with 9 years of schooling during this period (Oscarsson 1997).

Oscarsson (1997) analysed the effects of international trade on the wages of skilled and unskilled labour in Sweden during 1968-91. In the study, the differentiated zero profit condition in the Heckscher-Ohlin model of a small open economy is used to estimate proportional wage changes for different types of labour. These wage changes are needed to maintain zero profits when product prices and technology change. The model could not explain observed relative wage trends, when labour was categorised by educational levels into skilled and unskilled labour. The estimated mandated wage changes implied an increase in the relative wage for skilled labour but the actual relative wage decreased.

Since wages did not adjust according to the predictions of the Heckscher-Ohlin model one can expect that employment did. Import competition from low-wage countries put a downward pressure on the wages for unskilled labour but as they did not adjust, profitability must have decreased and structural change taken place. In this paper, the trade-off between wage and employment adjustment to international competition is analysed, following the approach taken in Grossman (1986, 1987) and Revenga (1992). They estimate reduced-form wage and employment equations by sector. In the

model imported and domestically produced goods are imperfect substitutes in each sector and labour is imperfectly mobile between sectors.

This paper advances on existing work in this area by extending the model to encompass two types of labour, skilled and unskilled, and by using highly disaggregated trade, wage and employment data. By separating labour into two groups the adjustment to import competition and technical change can be compared across groups, the underlying hypotheses being that both import competition and technical change have had more negative impact on unskilled labour than on skilled labour. The trade, wage and employment data per industry is on the 4 digit ISIC code level, which allows for a more accurate distinction between high-skill and low-skill intensive industries than an analysis of broad industrial sectors does.

Using a panel of 63 industries within Swedish manufacturing for the period 1975-93, the results show that import competition had a significant negative effect on the employment of both non-production and production workers. Non-production worker real wages were not affected at all by import competition, while it had a negative effect on production worker real wages. Since the effect on real wages was less in magnitude than the effects on employment, and even insignificant for non-production workers, labour was mobile across sectors in Sweden during this period. Adjustment to changes in import competition took place by employment changes rather than by wage changes. This result is in line with the structure of the Swedish labour market with low wage flexibility and an active labour market policy to support structural change. The estimates also indicate that non-production workers were more mobile than production workers. One possible explanation could be that non-production workers have less industry specific skills, which facilitates employment in other sectors. Technological change had a significant negative effect on the employment for both labour groups (equal in magnitude) and a positive effect on the real wage for non-production workers.

The results from previous studies give a rather mixed picture of the reasons behind the observed trends in the Swedish wage structure. Hibbs and Locking (1996), for instance, argue that the fall in wage dispersion for blue-collar private workers between 1970 and 1982-83 was a result of the solidaristic wage policy pursued by the trade unions. Centralised wage bargaining broke down in 1983, which coincides with a moderate general increase in wage inequality. Another view is taken by Edin and Holmlund (1995) who rule out institutional changes as the single major explanation for the increased wage inequality. They find that the fall in the university wage premium was driven by a rapid growth of university graduates in the labour force. This growth stopped in the middle of the 1980's, which caused a rise in the university wage premium. Arai and Kjellström (1999) raise some objections, concerning the analysis and conclusions drawn in Edin and Holmlund's study, in their review of existing results on returns to human capital in Sweden. They argue that the decreasing wage dispersion indeed was primarily generated by the institutions of wage setting. In their opinion, the growth in the supply of skilled labour was counteracted by simultaneous increases in the demand for skilled labour, and a possible reason for falling returns to education was that the expansion of higher education might have led to lower quality, rather than the expansion in itself.

Three studies concluding that skilled-biased technical change rather than international trade is the major driving force behind the increasing relative demand for skills in the manufacturing sector in Sweden are Machin, Ryan and Van Reenen (1996), Machin and Van Reenen (1998) and Hansson (1999). In the study by Machin et al (1996), a decomposition of the change in the proportion of skilled workers¹ employed in the manufacturing sector between 1973-89 shows that the vast majority of the increase in the proportion of skilled workers can be attributed to changes in the proportion of skilled workers within industries rather than between industries. This is also true for the wage bill share of skilled workers. There is evidence of capital skill complementarity, meaning that increases in the wage bill and employment shares of skilled workers are positively correlated with investments in physical capital. There is also evidence of new technology and skills complementarity, where new technology is measured as the ratio of R&D expenditures to value added. Over 80 percent of the increase in the wage bill share of skilled workers can be attributed to the R&D effect in Sweden. The study also finds weak evidence that import intensive industries had a faster increase in the wage bill share of skilled workers. In the later study by Machin and Van Reenen (1998) that results is however not statistically significant.

Hansson (1999) studies the period 1970-93. He concludes that the falling relative wages for skilled labour² during 1970-85 were caused by faster growth in the relative supply than in the relative demand for skilled labour. During 1986-93 both relative wages and the rate of skill upgrading increased, which indicate increased relative demand for skilled labour within Swedish manufacturing. This coincides with stronger complementarity between knowledge (R&D) capital and skills, and large investments in R&D during the same period. The impact on relative demand for skilled labour of intensified competition from the South (non-OECD) was small and the effect was concentrated to the textile industry.

In relation to the above mentioned studies, this paper gives some support to the hypothesis that international trade indeed had a significant impact on the labour market outcomes for unskilled and skilled labour. The fact that adjustment to international competition took place by employment changes rather than wage changes points to the need to consider not only relative wages but also relative employment opportunities when analysing the effects of international trade on the Swedish labour market.

The remainder of the paper is organised as follows. In section 2 the model is described. The data sources and some descriptive statistics are presented in section 3 and the regression results in section 4. Section 5 concludes the paper.

2. The model

The model in this paper is an extension of that in Grossman (1987) where he estimates the effects of import competition on sectoral wages and employment in the U.S. He uses a model where the factors of production are only partially mobile between sectors. Domestic production substitutes imperfectly for imported goods. For the purpose of this paper, Grossman's model is chosen since it comprises effects from

¹ Non-production workers.

² Employees with post-secondary education.

both trade and technology, on both employment and wages, and since it measures international competition in terms of import prices rather than import volumes. In this study the model is extended to encompass two different kinds of labour, skilled and unskilled, and is set up as follows:

The output of a representative importable goods sector i is produced with capital, K_{it} , skilled labour, S_{it} , unskilled labour, U_{it} , and energy, E_{it} , according to a Cobb-Douglas production function where p is the rate of Hicks-neutral technological progress and t denotes time.

$$(1) \quad Y_{it} = Ae^{pt} K_{it}^{a_1} S_{it}^{a_2} U_{it}^{a_3} E_{it}^{(1-a_1-a_2-a_3)} \quad a_1, a_2, a_3, A > 0$$

Energy is a traded input at an exogenous price of P_{et} . The profit maximising input of energy is

$$(2) \quad E_{it} = \frac{P_{it} Y_{it} (1 - a_1 - a_2 - a_3)}{P_{et}}$$

where P_{it} is the price of sector i 's output.

Capital and labour are non-traded factors and their aggregate stocks are exogenous with respect to the activity in a small sector. The derived demand for capital, skilled labour and unskilled labour are given by

$$(3) \quad K_{it} = \frac{P_{it} Y_{it} a_1}{r_{it}} \quad (4) \quad S_{it} = \frac{P_{it} Y_{it} a_2}{w_{it}^S} \quad (5) \quad U_{it} = \frac{P_{it} Y_{it} a_3}{w_{it}^U}$$

where r_{it} is the rental rate on capital in sector i and w_{it}^S and w_{it}^U are the wage rates in that sector.

Capital and labour are assumed to be imperfectly mobile between the sectors even in the long run. The fraction of the aggregate stock of each factor that is supplied to sector i is a function of its reward in sector i in relation to its aggregate rate of return. For capital

$$(6) \quad \frac{K_{it}}{K_{at}} = C \left(\frac{r_{it}}{r_{at}} \right)^c \quad c, C > 0$$

and skilled labour

$$(7) \quad \frac{S_{it}}{S_{at}} = D \left(\frac{w_{it}^S}{w_{at}^S} \right)^d \quad d, D > 0$$

and unskilled labour

$$(8) \quad \frac{U_{it}}{U_{at}} = F\left(\frac{w_{it}^U}{w_{at}^U}\right)^f \quad f, F > 0$$

where K_{at} , S_{at} , and U_{at} are the aggregate factor stocks and r_{at} , w_{at}^S and w_{at}^U are aggregate returns.

The real aggregate rates of return are determined by the aggregate stocks of the non-traded factors and the price of the traded factor. For capital

$$(9) \quad \frac{r_{at}}{P_{at}} = GK_{at}^{g_1} S_{at}^{g_2} U_{at}^{g_3} P_{et}^{g_4} \quad g_1 < 0, G > 0$$

and skilled labour

$$(10) \quad \frac{w_{at}^S}{P_{at}} = HK_{at}^{h_1} S_{at}^{h_2} U_{at}^{h_3} P_{et}^{h_4} \quad h_2 < 0, H > 0$$

and unskilled labour

$$(11) \quad \frac{w_{at}^U}{P_{at}} = JK_{at}^{j_1} S_{at}^{j_2} U_{at}^{j_3} P_{et}^{j_4} \quad j_3 < 0, J > 0$$

where P_{at} is the aggregate price level.

The output from sector i is assumed to substitute imperfectly for the import good with exogenous price $P_{it}^*(1+t_{it})$ including the ad valorem tariff:

$$(12) \quad Y_{it} = B\left(\frac{P_{it}^*(1+t_{it})}{P_{it}}\right)^{b_1} \left(\frac{P_{at}}{P_{it}}\right)^{b_2} Q_t^{b_3} \quad b_1, b_2 > 0, B > 0$$

where Q_t is the real national income.

This system of equations can be solved for 12 endogenous variables: E_{it} , Y_{it} , K_{it} , S_{it} , U_{it} , P_{it} , r_{it} , w_{it}^S , w_{it}^U , r_{at} , w_{at}^S and w_{at}^U as a function of the exogenous variables K_{at} , S_{at} , U_{at} , P_{et} , P_{at} , P_{it}^* , t_{it} and Q_t .

After taking logs the reduced form equations for employment and wages are as follows for skilled labour:

$$(13) \quad \log S_{it} = \mathbf{a}_0 + \mathbf{a}_1 t + \mathbf{a}_2 \log K_{at} + \mathbf{a}_3 \log S_{at} + \mathbf{a}_4 \log U_{at} + \mathbf{a}_5 \log P_{et} + \\ + \mathbf{a}_6 \log P_{at} + \mathbf{a}_7 \log(P_{it}^*(1+t_{it})) + \mathbf{a}_8 \log Q_t$$

$$(14) \quad \log w_{it}^S = \mathbf{g}_0 + \mathbf{g}_1 t + \mathbf{g}_2 \log K_{at} + \mathbf{g}_3 \log S_{at} + \mathbf{g}_4 \log U_{at} + \mathbf{g}_5 \log P_{et} + \\ + \mathbf{g}_6 \log P_{at} + \mathbf{g}_7 \log(P_{it}^*(1 + \mathbf{t}_{it})) + \mathbf{g}_8 \log Q_t$$

and for unskilled labour

$$(15) \quad \log U_{it} = \mathbf{b}_0 + \mathbf{b}_1 t + \mathbf{b}_2 \log K_{at} + \mathbf{b}_3 \log S_{at} + \mathbf{b}_4 \log U_{at} + \mathbf{b}_5 \log P_{et} + \\ + \mathbf{b}_6 \log P_{at} + \mathbf{b}_7 \log(P_{it}^*(1 + \mathbf{t}_{it})) + \mathbf{b}_8 \log Q_t$$

$$(16) \quad \log w_{it}^U = \mathbf{y}_0 + \mathbf{y}_1 t + \mathbf{y}_2 \log K_{at} + \mathbf{y}_3 \log S_{at} + \mathbf{y}_4 \log U_{at} + \mathbf{y}_5 \log P_{et} + \\ + \mathbf{y}_6 \log P_{at} + \mathbf{y}_7 \log(P_{it}^*(1 + \mathbf{t}_{it})) + \mathbf{y}_8 \log Q_t$$

where

$$(17) \quad \mathbf{g}_7 = \frac{\mathbf{a}_7}{d}$$

$$(18) \quad \mathbf{y}_7 = \frac{\mathbf{b}_7}{f}$$

and

$$(19) \quad \mathbf{a}_7 = \frac{b_1 d}{\frac{(d+1)(b_1 + b_2 - 1)a_1}{(c+1)} + (b_1 + b_2 - 1)a_2 + \frac{(d+1)(b_1 + b_2 - 1)a_3}{(f+1)} + (d+1)}$$

$$(20) \quad \mathbf{b}_7 = \frac{b_1 f}{\frac{(f+1)(b_1 + b_2 - 1)a_1}{(c+1)} + (b_1 + b_2 - 1)a_3 + \frac{(f+1)(b_1 + b_2 - 1)a_2}{(d+1)} + (f+1)}$$

After adding a disturbance term to each of the four equations (13)-(16) they can be estimated using time series data over a specific industry or by pooling data over industries.

Hypotheses – one specific industry over time

A decrease in the price of the imported good will lead to an inward shift in the demand for the domestically produced good which will lead to a price decrease on the goods market and thus decreased demand for labour in that sector. So we expect the import price elasticity for employment to be positive (\mathbf{a}_7 , \mathbf{b}_7). As demand for labour falls in the sector, so does the wage. Thus, we expect the import price elasticity for wages to be positive as well (\mathbf{g}_7 , \mathbf{y}_7). The relative effect between wages and employment is dependent on the mobility. The more mobile the labour is the more responsive is employment and the less so are wages.

The difference between the elasticities for skilled and unskilled labour with respect to import prices is dependent on how the factors are used in production and on their mobility.

Technical change gives rise to two counteracting effects on the demand for labour in the sector. The marginal product of labour increases, which leads to an outward shift in labour demand since the value of the marginal product increases. But at the same time the technological change decreases the marginal cost in production and creates a shift in supply on the goods market, which leads to increased production and lower product prices. This decrease in the product price leads to an inward shift in demand on the labour market. Depending on the size of these two effects, employment may increase or decrease (a_l, b_l). If the total effect is a decrease in labour demand wages will decrease as well (g_l, y_l).

3. Data

3.1 Sources

Employment and wages

To categorise labour into different skill groups is problematic. Skills are difficult to measure and there is an ongoing discussion about the problems related to the use of various variables. In this study manufacturing data are used where the workers are categorised as non-production and production workers respectively.³

The manufacturing data come from an annual survey where the information is collected from all establishments with 10 or more employees.⁴ The following variables are used

- number of production workers
- number of hours worked by production workers
- number of non-production workers
- wage sum for production workers excluding payroll taxes
- wage sum for non-production workers excluding payroll taxes.

From these data annual and hourly wages are calculated for production workers and annual wages for non-production workers. Monthly data for employment and wages are unfortunately not available for Sweden. In the analysis annual data is used covering the period 1975-93 for industries at the 4-digit ISIC code level. This restriction on data availability implies that single industry equations can not be properly estimated with only 19 observations. Therefore the data is pooled over industries to allow for enough degrees of freedom. The drawback using pooled data is

³ Wage earners and salaried employees respectively.

⁴ Manufacturing, various issues, Statistics Sweden. Starting in 1992 the first 14 days of an employee's illness are covered by "sick-wages" from the employer and not by the social insurance system. These "sick-wages" are included in the wage sums for 1992-93 which disturbs comparison of wages per employee (or hour) over time somewhat. However, leave-of-absence due to illness decreased a lot at the same time which diminishes the problem to some extent.

that we put a restriction on the estimated elasticities to be equal across the pooled industries.

Import prices

The import price index data collected by Statistics Sweden is not at the same industry level as the manufacturing statistics and there are many missing observations in the import price data series, both across time and across industries. Instead unit values are used in the analysis. The Centre for Economic Policy Studies (CEPS) has recently produced these unit values using the OECD trade database.⁵ The trade data is converted from product categories in the trade classification (SITC) to industrial sectors (ISIC).

Aggregate variables for the manufacturing sector

The remaining explanatory variables are aggregated over the entire manufacturing sector. The *capital stock data* is collected from the National Accounts.⁶ The variable used is the real capital stock valued at written down replacement costs. It includes buildings and machinery. *Stocks of production and non-production workers* are not available for Sweden since the statistics on the labour force is not categorised by production workers and non-production workers. As proxies for labour supplies, aggregate employment in the manufacturing sector of production and non-production workers are used.⁷ A series over medium-heavy fuel oil prices including taxes is used as *energy prices*.⁸ The consumer price index, CPI, is used as the variable for the *aggregate price level*.⁹ The real national income is used as *national income*.¹⁰ *Import penetration* is measured as imported value in relation to sales value per industry.¹¹ The shift in *technology* is modelled as a time trend 1, 2, ...19 over time per industry.

3.2 Descriptive statistics

Total employment in the Swedish manufacturing sector decreased between 1975 and 1993 from 925,299 to 544,531 employees, or by 41 per cent. The reduction in employment was especially pronounced in Ship and boat building and repair (ISIC 3841) where the employment of production and non-production workers have decreased by 90 and 80 per cent respectively. Another industry well known to been struck by international competition is Textile, wearing apparel and leather industries (ISIC 32) where production worker employment decreased by 80 per cent and non-production worker employment by 70 per cent between 1975 and 1993. Expanding industries in terms of employment are hard to find, but examples are Alcoholic beverages (ISIC 3131), Other paper and board products (ISIC 3419) and Drugs and medicines (ISIC 3522).

⁵ Globalisation and Social Exclusion project, funded by the EC under the TSER programme.

⁶ National Accounts, Statistics Sweden.

⁷ Manufacturing, various issues, Statistics Sweden. Employment within manufacturing has declined a lot during this period as employment has shifted towards the private and public service sector. The aggregate employment variables therefore probably underestimate actual labour supply in the manufacturing sector.

⁸ Energy in Sweden, Facts and Figures 1997, NUTEK Info 439-97.

⁹ Energy in Sweden, Facts and Figures 1997, NUTEK Info 439-97.

¹⁰ National Accounts, Statistics Sweden.

¹¹ Imported value is from the CEPS trade data set and sales value from Statistics Sweden.

The employment reductions were more extensive for production workers than for non-production workers. Total relative employment of non-production/production workers in the manufacturing sector increased from 0.38 to 0.54, or by 40 per cent during the period. Employees leaving the manufacturing sectors did not become unemployed to a great extent. The national unemployment rate was 1.6 per cent in 1975 and varied between 1.5 and 3.5 per cent until 1992 when it rose to 5.2 per cent and further to 8.2 per cent in 1993.¹²

Figure 1 Relative employment and relative annual wages within Swedish manufacturing 1975-93



Source: Manufacturing, various issues, Statistics Sweden.

Relative wages were fairly stable during the period 1975-93, in contrast to many other countries like the U.S. and the U.K. In the manufacturing sector the relative annual wage for non-production/production workers decreased from 1.513 in 1975 to 1.449 in 1993 which corresponds to a 4 per cent reduction.

The variation in employment, wages and import penetration across industries on the 4-digit ISIC code level is summarised in the table below (the figures are not weighted by industry size which causes discrepancies between previously mentioned aggregate relative wages and mean values for all industries). The industries are grouped into high and low import industries respectively. The division is based on the median import penetration value over all industries in 1993, which was around 0.58. Industries with an import penetration at or above the median are categorised as high import industries.

¹² Statistical Yearbook, various issues, Statistics Sweden.

Table 1 Summary over descriptive statistics 1975-93

Variable	All industries		High import ind		Low import ind	
	Mean	Std dev	Mean	Std dev	Mean	Std dev
% change in number of production workers	-40.8	42.4	-59.0	19.0	-23.7	51.6
% change in number of non-production workers	-21.0	50.0	-38.7	34.2	-12.5	40.9
% change in relative employment non-production/production workers	40.4	49.9	52.1	56.9	21.7	32.3
Relative wage non-prod/prod workers 1975	1.54	0.150	1.60	0.120	1.47	0.151
Relative wage non-prod/prod workers 1993	1.49	0.308	1.47	0.229	1.50	0.400
% change in relative wage non-production/production workers	-2.9	20.3	-8.6	13.5	1.6	25.7
% change in annual wage for production workers	326.6	113.1	342.7	155.3	312.7	57.2
% change in annual wage for non-production workers	300.0	32.5	287.7	32.8	307.6	28.3
Import penetration (imp/prod) 1975 ¹	0.49	0.47	0.70	0.42	0.29	0.44
Import penetration (imp/prod) 1993 ¹	1.11	1.93	1.96	2.44	0.24	0.16

Note: High import industries are industries with an import penetration (import/sales) greater than or equal to the median value in year 1993 which was 0.575517. All industries within manufacturing. The differences in means between high and low import industries are all significant (5% risk level) except the relative wage in 1993 and the change in the annual wage for production workers.

A first glance at the data shows that between 1975 and 1993 employment of production workers decreased by 41 per cent and employment of non-production workers decreased by 21 per cent on average among all 4-digit ISIC industries within manufacturing. Employment decreased a lot more in industries with high import penetration than in low import penetration industries. This is true for both production and non-production workers. Table 1 also reveals that relative employment of non-production/production workers has increased more in industries with high import penetration than in low import penetration industries.

Nominal wages have increased less for non-production workers in industries with high import penetration compared to low import penetration industries. Surprisingly, the opposite is true for production workers. The nominal wage increase was faster in high import penetration industries for this labour category. In industries with high import penetration the fall in relative wages for non-production/production workers was nearly 9 per cent. By contrast, relative wages increased in low import industries.

The average import penetration, measured as import value in relation to sales value, increased between 1975 and 1993 from 49 per cent to 111 per cent. In high import penetration industries the ratio increased from 70 to 196 per cent but the import penetration in low import industries decreased from 29 to 24 per cent.

4. Regression results

4.1 Specification

Employment and wage equations for non-production and production workers are estimated by a feasible GLS specification with industry specific constants. Assuming cross-section heteroskedasticity, meaning that the variance is assumed to differ across industries, estimated cross-section residual variances are used. The pooling of industries is made with the assumption that a common coefficient vector is feasible.

The data set covers the entire manufacturing sector and includes 63 industries at the 4 digit ISIC code level.¹³ The degree of import penetration differs considerably both across industries and across time. It is reasonable to believe that the impact of import competition is greater in industries where the degree of import penetration is high as compared to other industries. In order to let the effect of import competition on employment and wages vary depending on the level of competition, import prices (unit values) are interacted with the degree of import penetration per industry, period by period.

All nominal prices are divided by the CPI to take away any common inflationary trend. Unfortunately some of the other explanatory variables are correlated with each other as well. There is a strong positive correlation between the net capital stock and the real national income, and between the aggregate employment of non-production and production workers respectively. The model is therefore transformed by first differencing to reduce the multicollinearity problem.¹⁴

Tests for serial correlation on individual industries using the differenced equation show no common pattern for the four equations estimated.¹⁵ Sometimes there is no indication of serial correlation, sometimes there is a first-order autoregressive process and sometimes the process is of a higher order. This makes it difficult to correct for the serial correlation in a proper way. The pragmatic approach taken regarding the four equations to be estimated, is to assume a first-order autoregressive process for all industries, but to use estimated industry specific serial correlation coefficients.

Following Grossman (1986, 1987) and Revenga (1992) lags are introduced in the specification to deal with time for adjustment. Developments in the import competition may not affect wage bargaining or hiring/lay-offs until after some time. Changes in the net capital stock, in labour supply and in oil prices may also create adjustments in later time periods. The appropriate lag lengths most probably vary across industries, and between employment and wage adjustments. However, the

¹³ Some industries have been excluded from the regression analysis for reasons like breaks in the series or very high volatility in the trade data. The industries are listed in a note to table 2.

¹⁴ Even after transformation there is a strong correlation between the aggregate employment of non-production and production workers, and real national income respectively. The correlation coefficients are 0.78 and 0.77. The model is therefore re-estimated without the aggregate employment of production workers as an independent variable as a stability test. The results are reported in the appendix and show no major changes in the estimates for import prices and technology. The import price elasticities for employment increase somewhat.

¹⁵ Q-tests, Breusch-Godfrey Serial Correlation LM Tests.

small number of observations per industry does not allow too many lags. A lag length of one year is therefore introduced for the five variables mentioned.¹⁶

Import prices are assumed to be exogenous i.e. the supply of imports are assumed to be perfectly elastic. For Sweden, being a small economy, the import prices are most probably set on the world market and not specifically for the Swedish market. But as Revenga (1992) argues, the import prices may be correlated with the error term. If there is an unobservable world-wide cost shock in materials for instance, it will affect both the demand for labour in a specific industry and the import price in that industry. In the appendix an instrumental variables approach is used to estimate the employment and wage equations. Hausman tests indicated endogeneity problems only for the production worker employment equation.

4.2 Results

The results in table 3 show significant effects from import competition on the employment of both labour groups. The estimated import price elasticities evaluated at average import penetration are 0.057 for non-production workers and 0.009 for production workers.¹⁷ This means that a decrease in import prices (unit values) had a significant negative effect on employment in industries within the manufacturing sector. The negative impact was more severe for non-production workers. There was no significant effect of import competition on the real wages for non-production workers, but a significant negative effect on production workers real hourly wages. The elasticity at average import penetration is estimated at 0.006.

¹⁶ The adjusted R^2 increased using these lags compared to a specification without lags.

¹⁷ The elasticity is calculated as the sum of significant coefficients at 10% risk level multiplied by the average import penetration across all industries and periods, which is 0.737.

Table 2 All industries within manufacturing (ISIC 3) 1975-93, all variables in logs, first differences, estimated by FGLS, P-values within parenthesis, White Heteroskedasticity-Consistent SE and Covariance

Variables	Employment				Wages			
	Number of non-production workers		Number of production workers		Annual wage non-production workers/CPI		Hourly wage production workers/CPI	
Import price/CPI*	0.077	(0.0000)	0.049	(0.0000)	0.005	(0.2995)	0.007	(0.0587)
Import penetration								
...lagged one year	-0.021	(0.1468)	-0.037	(0.0238)	-0.007	(0.2632)	-0.006	(0.1611)
Time trend	-0.002	(0.0000)	-0.002	(0.0000)	0.001	(0.0000)	0.0001	(0.3269)
Real income	-0.194	(0.0136)	-0.128	(0.0522)	0.761	(0.0000)	1.391	(0.0000)
Net capital stock	-0.374	(0.0000)	0.013	(0.8582)	0.014	(0.7942)	0.041	(0.5207)
...lagged one year	-0.009	(0.8584)	-0.131	(0.0162)	0.283	(0.0000)	0.272	(0.0000)
Oil price/CPI	-0.032	(0.0000)	-0.022	(0.0004)	-0.028	(0.0000)	0.023	(0.0000)
...lagged one year	-0.046	(0.0000)	-0.023	(0.0019)	-0.060	(0.0000)	-0.039	(0.0000)
Total employment of production workers	0.402	(0.0000)	1.216	(0.0000)	-0.378	(0.0000)	-0.993	(0.0000)
...lagged one year	0.479	(0.0000)	-0.117	(0.1300)	0.372	(0.0000)	0.823	(0.0000)
Total employment of non-production workers	-0.124	(0.0133)	-0.561	(0.0000)	-0.012	(0.7017)	0.102	(0.0037)
...lagged one year	-0.294	(0.0000)	0.028	(0.6098)	-0.319	(0.0000)	-0.573	(0.0000)
Industry dummies	yes		yes		yes		yes	
Average import penetration	0.737							
Import price elasticity at average import penetration	0.057		0.009		-		0.006	
N	1062		1062		1062		1062	
Adjusted R ²	0.277		0.521		0.409		0.573	

Note: Excluded industries are 3131, 3132, 3231, 3232, 3511, 3512, 3530, 3540, 3821, 3822, 3829, 3841, 3845, 3851, 3852, 3853, 3901 and 3909.

The effects on real wages were less in magnitude than the effects on employment, and even insignificant for non-production workers. The conclusion, based on the model chosen for analysis, is that labour was mobile across sectors in Sweden during this period. Adjustment to changes in import competition took place by employment changes rather than by wage changes. This result is in line with the structure of the Swedish labour market with low wage flexibility and an active labour market policy to support structural change. The estimates also indicate that non-production workers were more mobile than production workers. One possible explanation could be that non-production workers have less industry specific skills, which facilitates employment in other sectors.

The effect of technological change was significantly negative for the employment of both labour groups.¹⁸ There was no difference in the magnitude of the effect for non-production and production workers. But technological change had a significant positive effect on the real wages of non-production workers while it had no significant effect on production worker wages.¹⁹

The estimated effects of import price changes on employment and wages are smaller than similar estimates for production workers in Grossman (1986, 1987), Revenga (1992) and Faini et al (1998).²⁰ However, the results in this study are highly significant except for the non-production worker wage equation.

In Grossman (1986) an employment equation was estimated for the U.S. steel industry on monthly data between 1973 and 1983. The total elasticity for employment with respect to the import price was significantly estimated at 1.026 and the point estimate for the time trend was -0.0077 . Grossman discusses possible causes for this secular shift from employment in the steel industry. He suggests, among other things, a general shift in employment to services and high-technology sectors and labour-saving technological progress in steel production. In Grossman (1987) nine separate industries were studied using monthly data for 1967-79. Only one third of the estimated elasticities were significant and the intervals for significant elasticities for employment and nominal wages were $(-0.184 - 3.020)$ and $(0.056 - 0.071)$ respectively.

Revenga (1992) and Faini et al (1998) used a general set-up with the unemployment rate and an alternative wage as some of the explanatory variables together with the import prices. In both studies the data was pooled over industries. Revenga's study covered 38 industries within U.S. manufacturing for the period 1977-87 and used quarterly data. Her OLS estimates were not significant but the instrumental variables estimate for the import price elasticity with respect to employment (hours worked) was 0.29 and significant. The effect of import prices on real wages was smaller at 0.062 (0.085 with an alternative instrument). This indicates high mobility between industries in the U.S. during this period. Faini et al estimated employment and wage equations for nine manufacturing sectors in two regions: the North and the South of Italy, using annual data covering the period 1980-94. The estimated elasticity for employment was significant at 0.118 in the North and at 0.100 in the South. Real wages in the south of Italy was not significantly affected by import competition while the real wage elasticity for the North was significant at 0.122. The results suggest that adjustment to import price changes was made by wage changes to a larger extent in the north of Italy than in the U.S while in the South the adjustment was entirely made by employment changes.

¹⁸ As modelled, technological change is captured by a time trend, which of course may pick up effects from a general shift in production away from manufacturing.

¹⁹ Since the focus is on the effects of trade and technology the rest of the independent variables are left without comments.

²⁰ All but Revenga use unit values. Revenga uses import price index data.

5. Conclusions

This paper has investigated the effect of import competition on employment and wages in the Swedish manufacturing sector using data covering the period 1975-93. The results show that import competition had a significant negative effect on the employment of both non-production and production workers. Non-production worker real wages were not affected at all by import competition, while it had a negative effect on production workers real wages. Since the effect on real wages was less in magnitude than the effects on employment, and even insignificant for non-production workers, labour was mobile across sectors in Sweden during this period. Adjustment to changes in import competition took place by employment changes rather than by wage changes. This result is in line with the structure of the Swedish labour market with low wage flexibility and an active labour market policy to support structural change. The estimates also indicate that non-production workers were more mobile than production workers. One possible explanation could be that non-production workers have less industry specific skills, which facilitates employment in other sectors.

The empirical evidence for Sweden showed that aggregate relative employment of non-production/production workers increased by 40 percent between 1975 and 1993. This can not be explained by import competition affecting production workers more negatively than non-production workers. On the contrary, the estimates show larger import price elasticities for non-production worker employment than for production worker employment. However, the effect on aggregate relative employment is also dependent on different import price trends in industries dominated by production workers and by non-production workers respectively as well as relative industry size.

Technological change had a significant negative effect on the employment for both labour groups (equal in magnitude) and a positive effect on the real wage for non-production workers. Thus, neither technological change can explain relative employment trends within manufacturing in Sweden during 1975-93.

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Appendix

Multicollinearity – excluding variables

Table A1 shows the results from the specification without aggregate employment of production workers.

Table A1 All industries within manufacturing (ISIC 3) 1975-93, all variables in logs, first differences, estimated by FGLS, P-values within parenthesis, White Heteroskedasticity-Consistent SE and Covariance

Variables	Employment				Wages			
	Number of non-production workers		Number of production workers		Annual wage non-production workers/CPI		Hourly wage production workers/CPI	
Import price/CPI*	0.083	(0.0000)	0.053	(0.0001)	0.008	(0.1217)	0.012	(0.0103)
Import penetration								
...lagged one year	-0.001	(0.9644)	-0.001	(0.9357)	-0.008	(0.1939)	-0.009	(0.0807)
Time trend	-0.003	(0.0000)	-0.004	(0.0000)	0.001	(0.0000)	0.002	(0.0000)
Real income	0.562	(0.0000)	0.937	(0.0000)	0.579	(0.0000)	0.826	(0.0000)
Net capital stock	0.383	(0.0000)	0.374	(0.0000)	0.216	(0.0000)	0.414	(0.0000)
...lagged one year	-0.265	(0.0000)	-0.293	(0.0000)	0.209	(0.0000)	0.152	(0.0000)
Oil price/CPI	0.002	(0.7739)	0.036	(0.0000)	-0.031	(0.0000)	0.010	(0.0056)
...lagged one year	0.012	(0.0987)	0.006	(0.4623)	-0.039	(0.0000)	0.009	(0.0746)
Total employment of non-production workers	-0.026	(0.4168)	-0.002	(0.9533)	-0.187	(0.0000)	-0.381	(0.0000)
...lagged one year	-0.046	(0.0880)	-0.091	(0.0016)	-0.080	(0.0000)	-0.016	(0.3809)
Industry dummies	yes		yes		yes		yes	
Average import penetration	0.737							
Import price elasticity at average import penetration	0.061		0.039		-		0.002	
N	1062		1062		1062		1062	
Adjusted R ²	0.257		0.437		0.403		0.505	

Note: Excluded industries are 3131, 3132, 3231, 3232, 3511, 3512, 3530, 3540, 3821, 3822, 3829, 3841, 3845, 3851, 3852, 3853, 3901 and 3909.

Endogeneity – Instrumental variables estimates

Revena proposes a source-weighted industry index of foreign costs as an instrument. The index should be correlated with the price of imports but as it is constructed using the aggregate producer price indexes for the exporting countries it should be uncorrelated with industry-specific shocks. This approach demands detailed knowledge of trading partners per industry period by period to establish the weights. A less demanding approach is to select some major trading partners and enter their producer price indexes directly into the first stage equation and estimate the weights that gives the best fit. However, this approach delimits the variability in the instrument over industries. The producer price indexes are therefore interacted by industry group dummies at 2 digit ISIC code levels (31-39) letting the country weights differ across these nine industry groups.

From the OECD STAN database five major exporting countries were selected. Together they supplied around 50 per cent of the total imported value in the manufacturing sector in Sweden in 1985. The countries selected are Germany, U.S., Finland, Denmark and France. Aggregated producer price indexes for the countries mentioned were collected from the OECD Main Economic Indicators 1969-96.²¹

The residuals from the first-stage equation were used as an additional independent variable to perform a Hausman test of endogeneity. Except in the production worker employment equation the residuals were not significant. The endogeneity problem is therefore considered as minor even if the hypothesis of endogenous import prices can not be completely rejected. Table A2 shows the regression results using the instrument.

²¹ The U.K. was the second largest exporter to Sweden in 1985 but unfortunately there are no producer price index values for the U.K. in the OECD data set.

Table A2 All industries within manufacturing (ISIC 3) 1975-93, all variables in logs, first differences, estimated by FGLS, P-values within parenthesis, White Heteroskedasticity-Consistent SE and Covariance

Variables	Employment				Wages			
	Number of non-production workers		Number of production workers		Annual wage non-production workers/CPI		Hourly wage production workers/CPI	
Import price/CPI*	0.041	(0.0005)	0.026	(0.0441)	-0.003	(0.5518)	0.010	(0.0072)
Import penetration								
...lagged one year	0.021	(0.2159)	0.003	(0.8411)	-0.002	(0.7347)	-0.009	(0.0301)
Time trend	-0.002	(0.0000)	-0.002	(0.0000)	0.001	(0.0000)	0.00004	(0.7406)
Real income	-0.210	(0.0399)	-0.097	(0.1330)	1.043	(0.0000)	1.348	(0.0000)
Net capital stock	-0.320	(0.0003)	0.063	(0.3502)	-0.020	(0.6644)	0.042	(0.5010)
...lagged one year	0.124	(0.0106)	-0.140	(0.0074)	0.300	(0.0000)	0.271	(0.0000)
Oil price/CPI	-0.039	(0.0000)	-0.024	(0.0001)	-0.029	(0.0000)	0.024	(0.0000)
...lagged one year	-0.039	(0.0000)	-0.022	(0.0020)	-0.031	(0.0000)	-0.043	(0.0000)
Total employment of non-production workers	-0.125	(0.0110)	-0.552	(0.0000)	-0.001	(0.9711)	0.100	(0.0046)
...lagged one year	-0.257	(0.0001)	-0.005	(0.9295)	-0.317	(0.0000)	-0.577	(0.0000)
Total employment of production workers	0.439	(0.0000)	1.156	(0.0000)	-0.458	(0.0000)	-0.977	(0.0000)
...lagged one year	0.378	(0.0001)	-0.073	(0.3072)	0.331	(0.0000)	0.829	(0.0000)
Industry dummies	yes		yes		yes		yes	
Average import penetration	0.737							
Import price elasticity at average import penetration	0.030		0.019		-		0.0007	
N	1007		1007		1007		1007	
Adjusted R ²	0.249		0.494		0.444		0.528	

Note: Excluded industries are 3131, 3132, 3231, 3232, 3511, 3512, 3530, 3540, 3821, 3822, 3829, 3841, 3845, 3851, 3852, 3853, 3901 and 3909.